INVENTIONS & INNOVATION

Project Fact Sheet

Prototype Development of an Industrial Fuel Cell Microgenerator

Benefits

- Could save 595 million Btu of natural gas per 40-kW installation annually
- Could save 2.1 trillion Btu annually by 2010
- Provides continuous production of 40 kW of AC electricity and 27,000 Btu/hr optional cogeneration heat for base-load, secure power applications
- Offers approximately 55% electrical efficiency; cogeneration would bring the overall thermal efficiency to nearly 80%
- Consumes only 5.2 SCFM of natural gas and 3.5 gal/hr of water under normal operation
- Decreases CO_2 emissions due to reduced fuel consumption

Applications

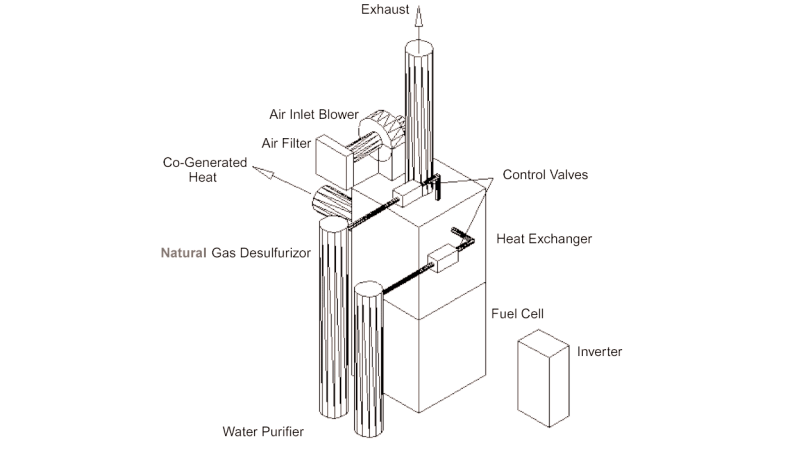
The potential buyers for industrial fuel cell microgenerators include banks, Internet service providers, computerized manufacturing and process control sites, clinics and nursing homes with life suort equipment, and restaurants and supermarkets with perishable inventories. In short, businesses that depend on an uninterrupted and economical supply of power constitute the market for this technology. The 40-kW generator will produce all the electricity and heat these buyers will need—onsite and using pipeline natural gas.

A New Design Makes Carbonate Fuel Cell Technology Economical on a Smaller Scale

Fuel cells are exceptionally clean compared with conventional fossil-fuel power sources. Aside from water, they create virtually no waste and, therefore, are attractive for power generation. Three fuel-cell technologies are currently under active development for stationary power generation—molten carbonate, solid oxide, and polymer electrolyte systems. A fourth technology, the phosphoric acid fuel cell, has already entered the commercial marketplace. These fuel-cell technologies are competing with microturbines for the next generation of stationary power applications.

The industrial fuel cell microgenerator, developed by Fuel Cell Technologies, Inc., in New Milford, Connecticut, is a new, low-cost, small-scale molten carbonate fuel cell power plant designed to improve the efficiency of small manufacturers. The generator is designed for continuous operation. Thus, if an electric grid fails, the technology will continue to provide power. The industrial fuel cell microgenerator will be competitively priced for small-scale onsite power generation of 30 to 50 kW. With a simplified fuel stack, the invention is scaled-down from existing molten carbonate fuel cells, which were developed for utilities. This new design provides a market opportunity for molten carbonate fuel cells.

Industrial Fuel Cell Microgenerator



This new industrial molten carbonate fuel cell microgenerator is highly efficient and was designed to meet the needs of small industrial and commercial markets.

Project Description

Goal: Design, build, and test the balance of plant (BOP) for a 40-kW carbonate microgenerator prototype to serve as a test bed for future demonstrations of the product.

The developers of the industrial fuel cell microgenerator have successfully improved the efficiency of the carbonate power plant, primarily by creating a new method for internally recycling the CO_2 in the anode exhaust. The startup burner and anode exhaust are incorporated within the fuel cell stack. This redesign makes a promising energy-conversion technology available for the first time on a smaller commercial scale. The anode exhaust system, subject of a recent patent filing, features independent combustion and quench air flows, protection of the cell components from direct combustion, and an innovative startup capability.

The only available technology for onsite power generation on this scale is the internal combustion engine generator which is loud, odorous, and expensive to operate. In terms of other emerging technologies, microturbines with generating capacities of 30 kW are in development. While these systems may be competitively priced, their electrical efficiency (20% to 25%) is less than half that of a carbonate system, which has net efficiencies from 55% to 60%, produces no nitrogen oxides, and is virtually silent.

Fuel Cell Technologies, Inc., is developing this new technology with the help of a grant funded by the Inventions and Innovation Program in the U.S. Department of Energy's Office of Industrial Technologies.

Progress and Milestones

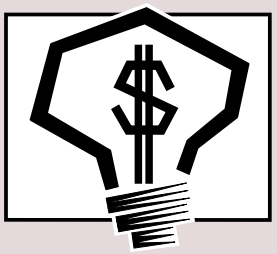
- Design the mechanical components of the microgenerator.
- Procure and assemble the BOP components and stack simulator.
- Perform tests to ensure BOP operability and safety.
- Update and refine market analysis and business plan.
- Form alliances with regional gas and electric utility companies to sell, service, and distribute the units.
- Negotiate additional sales directly with large customers, such as national and international fast food and supermarket chains.
- Maintain a competitive advantage through ongoing research and development to generate a patent stream and new product definitions.

Economics and Commercial Potential

Carbonate cells, backed up by the existing power grid, are expected to provide reliable power to digital manufacturing technology, computer-controlled equipment, and communications devices. Industry interest is apparent from sales of emergency-power generating equipment, which often outpace supplies during summer brownouts and severe weather. The need for secure high-quality power is currently being met by a variety of expensive high-maintenance equipment. The industrial fuel cell microgenerator should be highly competitive in this environment.

The primary target markets include small business and light industry within the general service class that has critical power quality and reliability requirements. At least 10% of these electricity consumers are expected to adopt the industrial fuel cell microgenerator. Based on this conservative estimate, sales in the third year following market entry are projected to be $10 million.

This technology could save 595 million Btu of natural gas per 40-kW installations each year. First sales of the technology are expected by 2003. Based on 8% new small-capacity market penetration by year 2010, annual savings could be 2.1 trillion Btu with 3500 units installed. Market penetration of 12% by year 2020 could save 13.7 trillion Btu annually from the operation of 23,000 units. Reduced fuel consumption resulting from this higher efficiency will translate directly into lower CO_2 emissions and will eliminate emissions of nitrogen oxide and sulfur.



The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

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